

48372/B

J. 2212

19/5

Mr. James W. Chan
Smith

W. Simpson
Compliments

Sept 30. 1868.

THE
ATTITUDE AND POSITIONS,
NATURAL AND PRETERNATURAL,
OF THE
FŒTUS IN UTERO,
ACTS OF THE REFLEX OR EXCITO-MOTORY SYSTEM.

BY
J. Y. SIMPSON, M.D., F.R.S.E.,
PROFESSOR OF MIDWIFERY IN THE UNIVERSITY OF EDINBURGH, AND PHYSICIAN-
ACCOUCHEUR TO THE QUEEN IN SCOTLAND, ETC.

EDINBURGH:
SUTHERLAND & KNOX, GEORGE STREET.

MDCCCLXIX.

[FROM THE MONTHLY JOURNAL OF MEDICAL SCIENCE.]



Plate I.



Attitude of the Fœtus
near the full term of utero-gestation.

Plate II.

Fig. 1.

Ovoid form of Uterus.



Fig. 3.

Adaptation of Foetus to Uterus.



Fig. 2.



*Ovoid form of Foetus.
at full time.*

Fig. 4.



*Foetus and Uterus
at fifth month*

ON THE

ATTITUDE AND POSITIONS

OF THE

FŒTUS IN UTERO.

PART I.

IN numerous important points, the physiology of the human foetus varies from the physiology of the human adult. The mechanism of some of the highest functions in the economy is different in the one from what it is in the other. The mode, for instance, in which nutrition is effected in the infant before it leaves the uterus, differs greatly from the mode in which nutrition is conducted in the individual after birth. The means by which respiration is accomplished during intra-uterine life, are very different from the means by which it is accomplished during extra-uterine life. The mechanism and course of the circulation is not the same in these two states of existence. After birth the circulation is double (systemic and pulmonary); before birth it is carried on as a single circulation, in an apparatus intended afterwards, and ultimately, to serve for a double circulation. The common attitude and position of the foetus and adult are equally different. The adult in his waking state, and whether walking or standing, carries the body vertically, with the head uppermost. The foetus in utero, for some time before birth, usually also carries the body vertically, but with the head placed undermost. The position of the head in relation to the body differs in the two states of being—in the adult it is placed higher than the body, in the foetus it is placed lower than the body.

At, and for some time before the full period of utero-gestation, the mode in which the child is situated in utero is generally as fol-

lows:¹—The trunk and spine are usually slightly curved, and the head is bent forwards, with the chin approaching toward the sternum. The thighs are drawn upwards and flexed upon the abdomen; and the legs are flexed and laid along the posterior surfaces of the thighs. The feet, which are sometimes crossed, are thus placed near the nates, and in front of them. In the interspace between the knees and face the upper extremities are situated, the arms being laid across the sides of the thorax, and the forearms flexed and crossed in front of the chest.² The whole foetus is thus flexed and rolled up into an *ovoid mass*, of such a form as to occupy the least possible space. One end of the ovoid is formed by the head, the other by the breech of the child.³

This ovoid is, in obstetric practice, found to be placed over, or to present at, the os uteri at the time of labour, in three different modes. 1. In a large majority of cases, the head or cephalic end of this ovoid mass is placed lowest in the uterus, and consequently presents at the time of birth. 2. Sometimes, however, the nates or pelvic extremity of the foetal ovoid is the lowest and presenting part. 3. Still more rarely the foetus is placed with its long axis lying transversely to the long axis of the uterus, and the presenting part is the side of the ovoid mass of the foetus; or, more strictly speaking, one of the shoulders or arms.

The following table shows the proportion in which these three leading genera of positions or presentations of the foetus at the full time of pregnancy, occurred in four large reports of cases furnished by Lachapelle, Boivin, Clarke, and Collins.

¹ Through the kindness of Professor Goodsir, I am enabled to give, in Plate I., a sketch of the attitude of the foetus in a subject brought into the dissecting rooms during the present winter. She had died of cholera, near the full time of utero-gestation. The placenta is seen situated on the right side of the uterus, opposite the right foot of the infant. In injecting the vessels, some wax escaped in the interspace between the two feet, and probably slightly altered their position.

² “The most common situation of the extremities is not to be determined, as they are found to be a little different in different dissections; and in the living body they vary almost every moment: thence the hands are seen indiscriminately on the head or face, or across one another, or around the knees or legs, or the legs are sometimes extended, and the feet are placed by the face, or one in that position, and the other contracted and the foot downwards.”—*Dr William Hunter's Anatomical Description of the Gravid Uterus*. P. 62.

³ “The foetus in utero,” says Hunter, “is naturally contracted into an oval form, adapted to the figure and circumstances of its habitation. The vertex of the head makes one end of the oval, and the nates the other. One side or edge of the oval is formed by the occiput, the back part of the neck, and the incurvated trunk; the other is made by the forehead, and the mass of contracted and conglomerated limbs. The chin is close to the breast, the trunk is bent forwards, the knees are close to the fore parts of the hypochondria, the legs drawn to the back parts of the thighs; the feet, or lower parts of the legs, decussating each other; and the upper extremities contracted into the vacant space betwixt the forehead and knees.”—*An Anatomical Description of the Human Gravid Uterus*. 1794. P. 62.

Table of the Relative Number of Cases in which the Presentation of the Child was found Cephalic, Pelvic, and Transverse.

Reporter.	Total No. of Cases.	No. of Head Presentations.	No. of Pelvic Presentations.	No. of Transverse Presentations.
Lachapelle,	37,126	35,550	1390	186
Boivin,	20,517	19,810	611	96
Clarke,	10,387	10,094	245	48
Collins,	16,654	16,102	504	48
Total,	84,684	81,556	2750	378
Proportions,		96 in 100	1 in 31	1 in 224

The preceding table shows the immense proportion of cases in which the head of the child is placed over the os uteri, and presents at the full term of pregnancy. In the above table, head presentations are in frequency, in proportion to all other presentations, as 26 to 1. The presentation of the pelvic extremity of the ovoid of the foetus, is to that of the cephalic extremity as 1 to 32. The presentation of the pelvic extremity, and its frequency in comparison to that of the head, is as 1 to 32 according to Desormeaux; as 1 to 33 according to Osiander; as 1 to 34 according to Carus; as 1 to 35 according to Meckel.¹ The transverse position of the foetus, with its long axis across, or at right angles to the long axis of the uterus, is by far the rarest of the three forms of presentation. In the preceding table of cases, it occurred only once in every 224 labours. Rigby² estimates it as occurring in about 1 in every 230 cases; Churchill³ estimates it as occurring in 1 out of every 261 labours.

Various opinions, and modifications of opinion, have been suggested in order to explain why the head of the infant is thus, before birth, usually placed lowest and over the os uteri, and why some special circumstances should occasionally change this law, and produce malpositions. None of the doctrines hitherto proposed seem to have at all proved satisfactory. Indeed, so much so is this the case, that latterly some authors have looked upon any successful inquiry into the causation of the attitude of the foetus in utero, as a matter beyond the legitimate limits of physiological investigation. Thus, M. Virey⁴ has strongly argued that we ought to content ourselves with considering the fact of the position of the head of the foetus opposite the os uteri, simply as an ultimate law in animal physiology, and a law quite general to the whole animal kingdom.

¹ See Adelon's *Physiologie*, tom. iv. p. 160, and Burdach's *Physiologie*, tom. iv. p. 224.

² *System of Midwifery*, p. 167.

³ *Theory and Practice of Midwifery* p. 356.

⁴ *Mémoire sur une loi de l'économie animale relative à la position des embryons et des foetus dans l'uterus.—Révue Médicale*, July 1833.

The law is perhaps not so general as M. Virey¹ supposes. But granting that it were even universal, still this admission could form no kind of logical reason against the propriety of investigating how in man, or in any other species, the effect in question is accomplished, and what mechanism is employed by nature for its production. At all events, if such an investigation be improper, then almost all our other physiological investigations are equally so. Every animal, from the lowest zoophyte up to man, respire, is nourished, and is propagated by generation. In other words, respiration, nutrition, and reproduction, are all of them ultimate and general laws in the animal kingdom; but their being so surely furnishes no reason for discarding all physiological inquiry regarding them, and would not entitle us to argue, as M. Virey does, that it is hence hopeless and improper to attempt to trace, for example, regarding reproduction or respiration, the variety of means and mechanism by which these ultimate laws are brought about and accomplished in man, or in the different series and classes of the animal kingdom.

At the present time, two opinions are principally or alone held by physiologists and obstetricians with regard to the mode of causation of the attitude of the foetus in utero with the head lowest. It is regarded by some as a result of the mere physical gravitation of the head. Others look upon it as a result of the action of vital or mental influences of an instinctive and voluntary character. In the sequel I shall first speak of these two opinions, and of the objections to which they are open. Afterwards, I shall endeavour to show that the natural attitude of the human foetus before birth, is the result of excito-motory movements on its part. I shall then consider the circumstances which lead to preternatural positions of the foetus, with a view of demonstrating that they are not only explicable by, but at the same time illustrative of, this new doctrine of the causation of the attitude of the foetus. And lastly, I may take an opportunity of offering some brief practical inferences and remarks.

SECTION I.—GRAVITATION OF THE HEAD AS THE CAUSE OF THE ATTITUDE OF THE FŒTUS.

The head is, proportionably to the body, far larger and heavier in the foetus than in the adult.² Most authorities have supposed that the position of the foetus in utero, with the head undermost, was

¹ I have more than once had an opportunity of dissecting the female of the common blue shark, (*Squalus cæruleus*), sometimes caught by the fishermen on our coasts here. The animal is viviparous; and in the distended uterus or oviduct, I found the enclosed foetus placed in nearly equal frequency with the head and tail directed towards the uterine opening.

² The encephalon of a new born child, according to Tiedemann, is so large as to be, relatively to the size of the body, as 1 to 6; in a full grown man it is as about 1 to 40.—*London Philosophical Transactions*, vol. xxvi., p. 503.

owing to the greater specific gravity of the head determining this part, in the erect position of the mother's body, to fall to the lowest part of the uterine cavity, or toward the os uteri.

The *period* of utero-gestation at which the preponderating gravity of the head is supposed to make it the lowest part of the fœtus, has been differently stated by different authors. Some, as Baudelocque,¹ Termanini,² Capuron,³ Meigs,⁴ and others,⁵ maintain that, from the earliest periods of pregnancy, this is the common and natural attitude of the fœtus. Others uphold, as Mauriceau,⁶ Rœderer,⁷

¹ System of Midwifery—Heath's Translation, vol. i. p. 260.

² "During the first six months of pregnancy," says Termanini, "it is certain that the fœtus enjoys so much mobility, that its position cannot but be determined by the respective weights of its constituent parts. The head of the fœtus is, in fact, the heaviest part relatively to all the others after the second month, and it results from this, that it tends constantly to direct itself inferiorly towards the orifice of the uterus."—*Archives Générales de Médecine*, vol. vi. p. 288.

³ Journal Universel et Hébdomadaire, tom. x. p. 437.

⁴ "The natural presentation is that of the head, which is turned towards the os uteri from the earliest period of pregnancy. The navel-string is nearer to the pelvis than to the head of the child, the head therefore hangs downwards; but when the cord, by the growth of the ovum, has become of a very considerable length, the child ceases to be dependent from it, for the cord is not unfrequently from twenty to thirty inches long."—*Meigs, Philadelphia Practice of Midwifery*, p. 229.

⁵ See Onymos, *Dissertatio de Naturali Fœtus in Utero Materno situ*; in Schlegel's *Sylloge ad Artem Obstetricam*, vol. i. p. 525; Gehler, *De Situ Fœtus in Utero*; in *Ibid.* p. 537.

"It is not," says Burdach, "as has been hitherto believed, towards the last period alone of intra-uterine life, and by a sort of culbute, but from the second month of this same life that the human embryo brings its head towards the inferior part of the uterus, or near its orifice. This phenomenon is the mechanical result of the erect position of the mother, since the umbilical cord is inserted at the inferior extremity of the trunk, and the upper half of the body, being the heavier, finds itself hanging."—*Traité de Physiologie*, vol. iv. p. 5.

"All the observations," says Hunter, "that I have been able to make in dissections, and in the practice of midwifery, would persuade me that the child's head is naturally downwards, through all the later months of utero-gestation; and that neither reason nor instinct teaches it, at any particular time, any trick of a tumbler or rope-dancer."—*Dr William Hunter's Anatomical Description of the Human Gravid Uterus*, p. 64.

⁶ "The spine of the child's back is placed towards the mother's; the head uppermost, and the feet downwards. It keeps usually this posture till the seventh or eighth month, at which, the head being grown very big, is carried downwards by its weight towards the inward orifice of the womb, tumbling, as it were, over its head, so that then the feet are uppermost, and the face towards the mother's great gut."—*Mauriceau, Muladies des Femmes Grosses, Chamberlen's Translation*, p. 147.

⁷ "I conclude," says Rœderer, "1. That the head of the embryo, which is extremely slender, and supported upon the chest, occupies the top of the uterus after conception; that it inclines towards the abdomen; and that the face is turned towards this part. 2. That it remains in this situation when some obstacle prevents it from descending; for example, a too small quantity of liquor amnii. 3. That it descends gradually according as it becomes heavier. 4. That

Levret,¹ Lamotte,² and others,³ that the position with the head downward, and directed to the os uteri, is only taken towards the latter months; and that it is assumed either gradually, or at last by a sudden movement and toppling on the part of the fœtus (the movement of *culbute* of the older authors). Sir Fielding Ould⁴ and Burton⁵ supposed that this downward movement of the fœtal head did not occur till the commencement of labour.

Whatever explanation may be given of the position of the infant in utero, one fact has been sufficiently established in regard to it by modern investigations; namely, that the position with the head lowest is not assumed till the latter months of utero-gestation. Before the beginning of the sixth or seventh month, the ovoid mass of the fœtus lies in utero, in nearly an equal number of cases, with its cephalic and its pelvic extremities lowest, or over the os uteri; and in a considerable proportion of instances it is still placed across or transversely, so that the trunk is opposite the os uteri. Hence in abortions, presentations of the feet or pelvis are nearly as frequent as presentations of the head; and presentations of the arm

at last, having become very large, it is carried downwards by its own proper weight. 5. Several causes may, however, prevent its descending, or derange its direction. I place in this class defect of the liquor amnii, obliquity of the uterus, tumours in the uterus, premature efforts, and external violence.”—*L'Art des Accouchemens*, p. 41.

¹ “The fœtus, after the fourth month of pregnancy, has the head above, the breech below, the belly in front; but when it approaches the period of its birth, it is the back which is in front, the head below, and the breech above. This observation proves that the infant, at the later periods of pregnancy, brings down its head to where its breech was before, and that it does so by bending forwards, whether gradually or all at once, and this is what the ancients have called the *culbute*.”—*Levret, L'Art des Accouchemens*, p. 74.

² “All authors,” says Lamotte, “agree that the child in the uterus has its back towards that of the mother, the heels backwards, the hands upon the knees, with the head resting on them till the seventh month; that at this time the head, growing heavier by the increase of its bulk, draws the body down, making it topple, and that then the head is below and the feet above, the face towards the mother's back; as to any thing else, remaining in the same posture it was in before, which is the situation in which it remains to the ninth month, and in which it comes into the world.”—*Lamotte, Treatise of Midwifery, Translation*

³ See Heister's *Compendium Medicinæ*, p. 111; Manningham's *Compendium Artis Obstetricariæ*, p. 10; Haller's *Elementa Physiologiæ*, vol. viii. p. 412.

⁴ *Treatise of Midwifery*, p. 25; and Preface, p. xiv.

⁵ “We must therefore,” says Burton, “assign some other cause, which according to Ould seems to be as follows, viz., that the whole spine is curved, and its head looks down, so that the fontanelle is just opposite the fore part of the mother's belly; and therefore as the first and greatest efforts for the expulsion of the child are in the bottom of the womb, which presses directly on the back of the head, as is evident from the posture of the fœtus in utero, and from the foregoing description of the womb, they must of course immediately turn the head downwards towards the vagina, and its face to the mother's back, especially as it is at this time floating in the waters. Hence it happens, that the change of the posture of the fœtus does not happen in a natural way till the first labour pains begin.”—*Burton's Essay towards a New System of Midwifery*, p. 100.

are by no means uncommon. In the Maternity Hospital of Paris, Professor Paul Dubois found, that out of 121 fœtuses, born alive or dead before the end of the sixth month, 65 presented by the head; 51 by the pelvis; and 5 were cross-births, or presented by the arm or shoulder. Further, the position of the head towards the os uteri, appears to be taken up more and more frequently and certainly from the end of the sixth month onwards. Out of 73 instances in which the child was born prematurely but alive, during the currency of the seventh month, Dubois found it presenting by the head in 61 cases, by the pelvis in 10 cases, and by the shoulder in 2 cases. Hence, while before the end of the sixth month the proportion of head presentations amounted to 55 in the 100, during the course of the next month, they were found already amounting to 82 in the 100; at the full time they amount, as we have previously stated, to 96 or 97 in the 100.

But at whatever period of the pregnancy the attitude of the fœtus is supposed to be taken, the whole idea of its head being placed lowest and opposite the os uteri, by physical gravitation merely, is a doctrine to the adoption of which there are the following insurmountable objections.

1. The doctrine presupposes that the mother's body is in the vertical or upright position, in order that the gravitation of the fœtal head may have the effect attributed to it. But during her hours of sleep and rest her body is placed horizontally and not vertically, and ought to afford many more chances than the statistical results show, of the head falling by mere gravitation into other positions and localities, than its usual and normal locality in the cavity of the cervix uteri. Besides, most practitioners have repeatedly seen patients restrained to the horizontal position for months before labour came on, without this position of the mother producing any deviation from the common position of the fœtus.

2. The doctrine further presupposes that the child is suspended in the uterine cavity by the umbilical cord.¹ But this is not in ac-

¹ "The fœtus," says Capuron, "is generally suspended from the uterus by the umbilical cord, and represents a kind of lever or hydrostatic balance with two arms immersed in the liquor amnii. These two arms commence at the umbilicus, and terminate the one at the apex of the head, the other at the heels or feet of the fœtus. * * * The head, which is placed at the extremity of the super-umbilical arm of the balance, must obey the gravitation which forces it down to the neck of the uterus."—*Mémoire sur la Situation du Fœtus pendant la Grossesse*;—*Journal Universel et Hebdomadaire*, &c., tom. x. p. 437. "The reason," says Hunter, "why the child's head is commonly downwards may be supposed to be this: the child is specifically heavier than the liquor amnii, and therefore, in the various attitudes of the mother, is always in contact with and supported upon the depending part of the uterus. This, in the more common attitudes, is the cervix uteri. The child's head and upper part of the trunk contain more matter, in proportion to their surface, than the lower part of the body; thence the head will more generally fall down to the

cordance with fact, at least it does certainly not hold good at that advanced period of pregnancy when, as we have just stated, the child no doubt assumes the position with the head downward, viz., in the latter months. In order to suspend the fœtus by the cord, the placenta, from which the cord springs, would, in the upright position of the mother's body, require to be fixed at the fundus uteri. The placenta, however, is almost always implanted on one side of the uterus,¹ rarely at the fundus. Further, in order to suspend the fœtus, the cord itself, as the medium of suspension, would require to be at least considerably shorter than the length of the uterine cavity, in which it is supposed to perform this function of suspension. But it is far too long to effect such a purpose. It is in general from eighteen to twenty inches, while the whole depth of the pregnant uterus is not above twelve or fourteen inches. * The physical conditions, in short, necessary for the supposed physical suspension of the fœtus by the cord, assuredly do not exist in the latter periods of pregnancy, when the fœtal head first comes to assume the position downwards.

3. When physical conditions exist the very opposite of those that have been supposed necessary to effect the suspension of the fœtus by the umbilical cord, these conditions do not make any corresponding deviation in the position of the child. When the cord is twisted and fixed around the neck of the infant, it makes the lower half of the fœtus, from the neck downwards, by far the longest and heaviest end of the supposed balance, and hence ought, according to the doctrine of gravitation, to make, in these circumstances, the pelvic instead of the cephalic end of the child the presenting part. Here, however, fact does not accord with theory. In about one in every seven cases, according to Dr Churchill² (in 174 cases out of 1271 labours), the cord is found coiled around the child's neck or limbs, and yet without the usual position of the head being altered by it. Out of 1417 labours among the patients of the Edinburgh Maternity Hospital,³ the cord was twisted around the child's neck once, twice, or oftener, in 164 instances, or in one in every eight cases; and in seven other instances, it was coiled both around the neck and limbs; but without changing in any of the cases the position of the infant from its normal direction with the head downwards.

4. If the physical gravitation of the head of the child were the cause of the normal position with the head lowest, then this position ought to be found with more frequency and certainty when

lower part of the uterus."—*Anatomical Description of the Human Gravid Uterus*, p. 66.

¹ See Naegele on Auscultation, Translation of Dr West, p. 79; Velpeau's *Traité d'Accouchemens*, vol. i. p. 297.

² Researches on Operative Midwifery, p. 281.

³ See Monthly Journal for November 1848.

the gravitation of the head from any cause was rendered proportionally greater than natural; with less frequency and certainty, when from other causes the gravitation of the cephalic extremity of the infant was rendered proportionately less than natural. The very contrary, however, of all this is the truth. In cases of intra-uterine hydrocephalus, the child's head is larger and heavier than usual; and sometimes it is so to an excessive degree. But this condition of the head, this increased preponderance and gravitation of it, does not render head presentations in these cases more common than usual, but the very reverse. In an excellent thesis on hydrocephalus of the fœtus as a cause of rupture of the uterus—my young friend, Dr Thomas Keith, last year collected the histories of 69 cases of intra-uterine hydrocephalus at birth. Of these 69 hydrocephalic fœtuses, 11 presented preternaturally, or 1 in 6. When the head and fœtus is normal, preternatural presentations occur, in proportion to other presentations, as 1 to 26. Hence, preternatural presentation was four times more frequent in hydrocephalic than in natural cases; while it ought to be more frequent in the former than in the latter, if the doctrine of gravitation were true. Again, anencephalic fœtuses, with the whole brain and arch of the cranium wanting, are still often found presenting naturally. I have been present at the birth of three anencephali that had reached the full term of pregnancy. All of the three presented with the deformed and diminished cephalic extremity over the os uteri.

5. When a human fœtus of the latter months is placed experimentally in fluid, in descending through the fluid the head does not turn and fall first to the bottom of the containing vessel, as the theory of gravitation takes for granted that it would. Thus, if a dead new-born fœtus be plunged into water, contained either in a vessel shaped like the uterus, or in a large bath, the part which gravitates, and strikes the bottom of the vessel or bath first, is the back or scapula, and not the head. M. Dubois first pointed out this fact as the result of numerous experiments which he had made on fœtuses from the fourth to the ninth month; and in several instances in which I have repeated the experiment, I have found the same result.

6. When the child dies in utero, it still continues to be subjected to the same physical laws as when it is alive. The mere death of the fœtus does not in any way remove it from the agency of gravitation. When all its vital actions have ceased, the body should in fact be more subject than heretofore to all influences, such as gravitation, which are merely physical in their character. The dead infant ought therefore, as frequently as the living, to have its head placed as the presenting part over the os uteri, provided the mere physical gravitation of the head were the reason and cause of

that position. Experience, however, amply proves that this is not the fact. In other words, experience proves that malpositions of the child, or the presence of other parts than the head at the cervix and os uteri, is in the latter months a far more frequent occurrence when the child is dead, than when it is still alive.

During the seven years that Dr Collins had charge of the Dublin Lying-in Hospital, 16,654 children were born within the house. Of these 16,654 children, 15,533 were born alive, and 1,121 dead. Of the 1,121 dead children, many no doubt died during labour; but 527 of them were in a putrid state, and consequently may be correctly regarded as having perished in utero, and before labour commenced. Among the 15,533 children born alive, 278 presented preternaturally, or 1 in 57; 250 presented by the pelvic extremity, or 1 in 62; 28 presented by the upper extremity, or 1 in 555; 15,255 presented by the head, or 98 in 100. On the other hand, among the 527 children born putrid, as many as 94 presented preternaturally, or 1 in 5; 88 presented by the pelvic extremity, or 1 in 6; 6 presented by the upper extremity, or 1 in 88; 433 presented by the head, or 83 in 100. This contrast between the proportions of preternatural and natural positions among the living and dead children, may be expressed in a tabular form as follows:—

Relative Proportion of Natural and Preternatural Presentations among Living and Putrid Children.

Presentation.	With 15,533 Living Children.	With 527 Putrid Children.
Cephalic Presentations . . .	15,255, or 98 in 100	433 or 83 in 100
Pelvic Presentations . . .	250, or 1 in 62	88 or 1 in 6
Transverse Presentations . .	28, or 1 in 555	6 or 1 in 88

7. The position of the fœtus in utero, with the head lowest, is a vital action, and dependent upon the existence and continuance of life in the infant; and consequently it is not simply a mechanical result, and dependent upon the mere preponderating weight of the head of the child. The last paragraph (6.), proves that the position of the head at the os uteri, is by no means so frequent when the fœtus is dead, as when it is alive; that, in other words, its *vitality* is in some way or another connected with the existence of this particular position, with the head undermost and over the os uteri. One objection may be urged against this deduction, as derived from the preceding data regarding putrid children, viz., that as “putrid” fœtuses are often born prematurely, the frequency of their malposition may depend upon the prematurity of their birth, and not upon the fact of their death. In some of the data drawn from the Maternity Hospital of Paris, and published by Professor Dubois, there is an answer to this objection. I have already stated, that out of 73 children born prematurely, but alive, during the currency of the

seventh month of pregnancy, Dubois found that 83 per cent., or 61 in the 73 cases, were head presentations: the pelvic extremity presented in 10 instances out of the 73, or in one case in 7; and the shoulder presented in 2 instances. These children were, I repeat, born *alive*. But when the children born during the course of the same seventh month of utero-gestation were already *dead*, the results were very different. Out of 46 children thus born prematurely, but dead, during the currency of the seventh month, 45 per cent. only, or 21 in the 46 cases were head presentations; the pelvic extremity presented in 21 instances out of the 46, or in about 1 case in 2; and the shoulder presented in 4 instances. The following arrangement expresses these curious facts in a tabular form:—

Table of the Relative Presentations among Children born prematurely during the Seventh Month, as affected by the Life or Death of the Child.

State of Child.	Total Cases.	Shoulder.	Pelvis.	Head.	Proportion of Head Cases.
Alive .	73	2	10	61	83 in 100
Dead .	46	4	21	21	46 in 100

The data which I already adduced in a preceding page, prove that the fœtus does not take any very determinate position till nearly the commencement of the seventh month; and that during the course of the seventh month, the position with the head downwards begins to be assumed with considerable frequency and certainty. The data in the present table further prove, that the position with the head downwards is lost, or not taken, provided the infant be dead. Or, in other words, the table shows what I have stated at the commencement of the present paragraph, that the assumption and maintenance of the position of the fœtus with the head undermost, and over the os uteri, is dependent upon the existence and continuance of *life* in the child, and consequently is not a physical, but a *vital* action.

The next question, therefore, which meets us is this,—What is the nature and character of the *vital* action by which the fœtus obtains and keeps up its position in utero with the head lowest? The assumption and maintenance of any position of the body, if dependent not upon physical but upon vital causes, can result from no other known vital action than a muscular action. Human physiology presents us with no other known action or power whatever, except muscular action, that can produce motions capable of altering or regulating the position either of the whole body or of any of its parts. And the real question, therefore, resolves itself into this—What is the nature and character of the *muscular* action by which the fœtus assumes and maintains its position in utero with the head lowest?

SECTION II.—INSTINCTIVE AND VOLUNTARY MUSCULAR ACTIONS AS THE CAUSE OF THE ATTITUDE OF THE FŒTUS.

Some physiologists, as Cabanis, Ennemoser,¹ &c., have upheld that the unborn fœtus is already endowed with physical powers, and performs acts referrible only to the existence and exercise of mind. They maintain that metaphysicians have as yet one department of their science to investigate, viz., the state and degree of development of psychical life in the intra-uterine fœtus. Cabanis² holds that the unborn infant already possesses the consciousness of its own existence with the first traces of fundamental ideas, and has already wants and desires, and both the will and the power of exciting volitional muscular movements.

Long ago, Ambrose Paré,³ and Chamberlen,⁴ attributed the position of the head of the infant at the os uteri in labour to a psychical rather than a physical cause. But the author who has principally maintained and developed the idea, that the position of the child is a psychical result, is Professor Paul Dubois of Paris.

In 1832 this distinguished obstetrician communicated to the Academy of Medicine of Paris, an elegant and remarkable essay on the subject. M. Dubois' essay is published in the second volume of the Academy's memoirs, under the title of "*Memoire sur la cause des Présentations de la Tête pendant l'accouchement et sur les déterminations instinctives ou volontaires du fœtus humain.*"

After showing, by some of the arguments that I have stated in the preceding section, that the position of the fœtus, with the head lowest and over the os uteri, is certainly not the result of gravitation, M. Dubois, by a kind of reasoning by exclusion, comes to the conclusion, that the position in question must be the result of

¹ Historich-physiologische Untersuchungen ueber den Ursprung und das Wesen der menschlichen seele. Bonn 1824.

² Rapports du Physique et du Moral de l'Homme, tom. ii. p. 431.

³ After speaking of the infant, at the full term of pregnancy, requiring more food than it can now obtain through the vessels of the cord, Paré describes it as endeavouring violently to escape from the uterus to supply its wants, and thus, by its strong violence (*grande impetuosité*), breaking the membranes. When the womb then begins to open, "the childe (says he), pursuing the aire which hee *feeleth* to enter in at the mouth of the womb, is carried with its head downwards."—*Paré's Works*, English translation, p. 899.

⁴ Of the celebrated obstetric family of the Chamberlens—the inventors of the forceps—we have few or no literary remains. Hugh Chamberlen, one of the sons, translated the work of Mauriceau, and has added a few sparse notes of his own. To the passage which I have already quoted in a preceding page from Mauriceau, regarding his belief in the preponderating weight of the head of the fœtus being the cause of its common position, Chamberlen affixes as an annotation, that the foetal head comes lowest, and to the os "rather by a natural *propensity* than any weight of the head."—*Translation of Mauriceau on Diseases of Women with Child*, &c., p. 147.

instinctive and voluntary determinations on the part of the fœtus, for he confesses himself unable to conceive any other influence by which it could be effected.¹

The terms, however, used by M. Dubois, "instinctive and voluntary," are so much of a conventional character, and are liable to have such different significations attached to them by different writers and readers, that it is necessary for us to understand the meaning which M. Dubois himself affixes to them, in order that we may justly appreciate his views and reasoning on the subject. M. Dubois enables us to do this by an illustrative explanation, which he himself gives of the terms, in a note appended to his essay, while, at the same time, he confesses how difficult it is, in relation to some notions and actions, to separate and limit the effects of instinct from the effects of volition and individual mental intelligence.

A bird builds a nest. The building of the nest is, says M. Dubois, an instinctive act, and the object of an irresistible impulse; as well as are the form or general plan and materials of its construction in each particular species. But, in his opinion, the means by which this instinctive determination is attained, such as the choice of an expedient place, and the search for, seizure, and carriage of the materials appropriate for the edifice, so far involve and imply, in different shades, acts of individual mental activity and volition—"voluntary determinations"—on the part of the bird.

By the word "instinctive," therefore, as applied to the attitude of the fœtus, M. Dubois implies the fact, that the situation of the head over the os uteri, is an act performed by the infant, independently of all experience and all imitation; and with the object and view of placing its head in the position which is most favourable for its safety and protection during labour. The word, in short, signifies that the *final cause* of the position is one of wisdom and foresight; and every person will, I believe, readily grant this part of the proposition. Any other position would endanger far more greatly the safety of the child, and consequently the whole object of the function of reproduction, viz., the continuance of the life of the species. The principal peril which the fœtus undergoes during labour, is the

¹ "M. Dubois," says Dr Ramsbotham, "has ascribed the general situation to an instinctive impulse implanted in the fœtus, which inclines it to take the most favourable position for its escape—as the needle points mysteriously to the pole. But such a mode of reasoning and illustration cannot be considered either as argumentative or conclusive; it is, in fact, completely evading the question, after attempting to elucidate it; and the method he has taken can only be regarded as a cloak for human ignorance. It would, in my opinion, be much better not to endeavour to explain the secrets of nature, so deeply hidden, but to content ourselves with referring this also to a general, though not invariable law—a part of the great system which shows the design, and exemplifies the harmony that reigns throughout the whole works of Providence."—*Obstetric Medicine and Surgery*, p. 309.

danger of asphyxia from compression of the umbilical cord. In head presentations, however, the risk of this accident is immeasurably less than it is in pelvic or transverse presentations. The whole figure of the child is that of a cone,—the head forming the basis of the cone, and the feet its apex. When the head or basis of the cone presents, and dilates the passages first, then, after the birth of the head, a single pain generally expels the body, and the chances of compression of the cord come thus to be rendered exceedingly slight. But when the apex of the cone (the feet or pelvis), is placed at the os uteri, and advances first into the passages, the cord is subject to much greater chances of compression between the mother and infant; for the higher and broader end of the cone then slowly, and with gradually increasing difficulty, makes its transit through the pelvis, the cord becoming more and more liable to compression during this transit. Many more children are consequently born dead under transverse and pelvic, than under cephalic presentations.

We acknowledge then willingly in this sense, the truth of M. Dubois' expression of the position of the child being an "instinctive determination," in as far as the final cause or object of the position is concerned. But we believe that he takes an erroneous view of the subject when he adds, that the mechanism by which nature effects this instinctive determination of the head downwards to the os uteri, consists of an almost constant series of movements, produced by "intentional determinations," and "small volitions" (*petites volontés*), on the part of the fœtus. The position of the fœtus is, I believe, certainly the result of the movements which it itself performs in utero; but these movements are not of a volitional, and consequently mental origin, but simply of a reflex or excito-motory character. Before pointing out the proofs of this view, let us glance at what the intra-uterine movements of the fœtus really are; and in doing so, I shall principally follow and abridge the lucid statements of M. Dubois himself.

When we apply and press our hand over the pregnant uterus, in the latter months of pregnancy, movements of the fœtus are often produced, and these movements are simultaneously perceived by us and by the mother. Touching and irritating the fœtal head through the os uteri during labour, generally leads to the same result. The pressure of the end of the stethoscope upon a projecting part of the body of the fœtus, almost always produces fœtal movements. Sometimes it can be felt striking its limbs, as it were, against the instrument, or against the uterine parietes, when we have occasion to use auscultation during pregnancy or labour. "Pregnant females," says M. Dubois, "can generally make and provoke fœtal movements at will; for there are few mothers who, in attempting to seize or tickle through the abdominal walls the small fœtal feet which sometimes press painfully against and protrude these walls, have not felt the infant immediately draw them back, in order to take up another

position, or answer by a rapid blow to the impression which it perceives." Warm or cold bodies when swallowed, or when applied to the abdomen externally, have sometimes a marked influence upon the movements of the fœtus in the way either of increasing or suspending them.¹

"Thus," adds M. Dubois,² "not only the susceptibility and the power of locomotion are exercised during foetal life, but even the regular and almost constant succession of impressions perceived, and of movements resulting from these impressions, indicates sufficiently that in the fœtus there is the same connexion between these two functions as exists in the adult. The fœtus in the uterine cavity has the feeling of external impressions, and these command (so to speak) the exercise of its powers of locomotion; and this faculty is found nowhere in the animal kingdom without being associated with spontaneous and intentional determinations, and consequently with internal perceptions, which ordain them."

These foetal movements, M. Dubois further shows, are generally exerted and repeated under certain determined conditions, as, for instance, under great changes of position on the part of the mother, as when she suddenly sits up or lies down. In some mothers, particular positions on the side, back, &c., always produce them. When the mother's stomach is empty, the foetal movements sometimes become excessive. And he adds, "When it happens accidentally, during pregnancy or labour, that the umbilical cord of the child becomes compressed, the fœtus testifies by repeated movements both the sentiment of restraint which it feels, and its wish to be relieved from it."

From these facts M. Dubois³ draws the following conclusions:—"The human fœtus, therefore, possesses the faculties of sensation and motion, and these faculties of sensation and locomotion are already related the one to the other in the same manner as they are destined to be during the whole life of the individual. In the narrow sphere of its existence, it has wants, the feeling of well-being and perhaps of pain; habits, and perhaps desires, and volitions; its

¹ In this instance—viz., the apparent foetal movements following the impressions of cold or heat applied to the surfaces of the abdomen or stomach—the uterine walls are probably *first*, if not alone, affected through their reflex system of nerves. All the different varieties of movements mentioned in the text have been maintained by Eggert (see *Rust's Magazin*, vol. xvii. p. 62) to be movements in the uterine or abdominal walls alone, and not in the fœtus. Every physician and mother can easily prove, by their own daily experience, the unsoundness of such a view. In speaking of the foetal movements apparently following sudden external impressions of heat and cold, M. Dubois states, that "in rural economy they take advantage of this fact to ascertain if chickens have perished in their shells before the end of incubation. With this view they plunge the suspected eggs into cold water, and immediately the movements of some show the enclosed fœtuses to be still alive; the immobility of others show that in them the chicks have perished."

² *Mémoires de l'Académie Royale de Médecine*, Tom. II. p. 280. ³ *Ib.* p. 284.

movements are often the decided indications of these feelings and desires, as its cries will be after its birth. Further, if any of its movements appear to us to be altogether automatic, it is only because we have not studied them so profoundly as to discover their cause or guess at their intention."

"Having demonstrated that the foetal movements have an object, sometimes fixed, sometimes only to be guessed at, and that they may, consequently, be looked upon as true instinctive determinations, we have only further to prove that it is in consequence of a determination of this sort that the head of the foetus in the mammalia is generally found situated at the pelvic end of the uterus. This point we shall demonstrate in very few words, for the proof itself results from the very facts which we have already adduced. If by some of these facts we have demonstrated that it is not by the laws of gravitation that the head of the foetus is drawn towards the uterine orifice,—if by other facts we have shown that, during intra-uterine life, some acts depend upon an instinctive or voluntary action, then it appears to us altogether impossible not to class among these last the almost constant position of the head at the os uteri; for it is only possible to choose between this cause and mere chance (*le hazard*); the choice of intelligent men in this case cannot be doubted."

These conclusions of M. Dubois are, I believe, not what the facts themselves warrant and point to. We fully admit the truth of his premises regarding the extent and variety of muscular movements performed by the foetus; we further believe, as will be subsequently shown, that these movements constitute the immediate cause and mechanism of the peculiar attitude and positions of the foetus; but we altogether dissent from the deductions which he has drawn from his data with regard to the actual physiological nature or character of these movements. They are not the result of the "spontaneous determinations" of the foetus: they do not prove, as he supposes, that "the faculties of sensation and motion are developed and exercised long before birth," already connected together, as in the adult, by intermediate mental operations, such as sensation and volition; they are not *psychical* nervous actions, but *physical* nervous actions; they are not, in short, volitional or sensorio-volitional movements, but movements entirely of a reflex or excito-motory character; movements not dependent on the cerebral system, but referable entirely to the "true spinal system."

It is well known that modern physiology and medicine stand indebted to the masterly and beautiful investigations of Dr Marshall Hall, for systematizing and elaborating our knowledge of a large and most important class of animal muscular movements, that are fundamentally altogether independent of sensation, consciousness, or volition, and consequently are not mental in their origin or working; that are connected with the spinal cord as their nervous centre or centres, and not with the brain, and may hence be performed when all influence from the brain is entirely removed;—and that originate

in impressions, made principally upon mucous and cutaneous surfaces, which impressions being conveyed from these surfaces by afferent, excitor, or incident nerves (as they are variously termed) to the spinal centre, lead thus indirectly to many and often complex muscular movements through some of the motory nerves connected with that centre becoming in consequence secondarily excited. The resulting movements are termed reflex or excito-motory, because they are induced by excitations transferred or reflected from one set of nerves to another, that is, from the excitor to the motory nerves, through an intermediate nervous centre. The movements of the fœtus in utero are of this reflex or excito-motory character. That they are so is, I think, proved by the fact, that in all important points they correspond with the most fixed characteristics of other undoubted forms and varieties of reflex or excito-motory muscular actions. The principal characteristics of true reflex movements consist,—1. In the anatomical conditions under which they are capable of being performed; 2. in the origin and character of the movements themselves; and 3. in the physiological object or objects with which they may be performed. I proceed to show briefly, that in these various particulars the movements of the fœtus in utero correspond to the proper characteristics of true reflex or excito-motory movements.

1. *The Anatomical Conditions under which the Movements may be performed.*—Dr Hall and others have shown, that true reflex or excito-motory movements persist in decapitated animals, when all influence of the brain, and consequently of sensation and volition, is necessarily removed. In instances of paraplegia in the human subject, dependent upon complete destruction and division of the spinal cord in the dorsal region, and hence when the agency of the brain was entirely cut off, reflex muscular movements sometimes remain in the muscles of the lower extremities, and are capable of being excited, sometimes violently, by slight irritations applied to the soles of the feet, &c.—the patient *seeing*, but not feeling, or being otherwise aware of the resulting movements in his own limbs.¹ That the fœtal movements are of the same character, is so far proved by the anatomical fact, that they may occur and go on during the period of intra-uterine life, and even for a day or two after birth, when, from malformation, the brain is entirely absent. The histories of cases of anencephalous monsters show that the intra-uterine movements are the same with them as with other children; and I have seen one survive for thirty-six hours after birth, performing various excito-motory movements during that time,—swallowing, crying, and moving the limbs when

¹ Cases of the same kind have been recorded by Lallemand, St Hilaire, &c., &c. See Dr Hall's Work, p. 134; or St Hilaire's *Histoire des Monstruosités*, Vol. II.

the skin was pinched or irritated.¹ These cases afford us evidence of this amount—that all the usual foetal movements are capable of being performed without a brain, and consequently without the agency of mind, and hence are not of a sensational or volitional character, but fall within the class of reflex or excitory movements.

2.—*The Origin and Character of the Movements.*—If *after* birth we irritate the sole or palm of the new-born infant (whether awake or asleep), muscular movements are excited in the limb. These are acknowledged by all physiologists to be excito-motory movements, as much so as the closure of the lips around the finger or nipple. If, *during* labour, the foot or hand present, and we irritate in the same way the protruded limb, it will excite motion in it of the same kind, as I have in several cases taken an opportunity of ascertaining. During labour, irritation of the scalp of the child with the finger, in common head presentations, is usually followed in the same way by some movement of the head. Go a step further back in the life of the infant, and apply similar irritations to the limbs or surface of the infant through the abdominal walls *before* birth, or during pregnancy, and, as we have seen, the same results are obtained; movements of a similar kind are excited, and the irritated limb is moved away. But these movements are to the feelings of the mother exactly the same in character, as those which are usually and constantly perceived by her as made by the unborn foetus within her. Their independence of the brain, and true excito-motory character, is proved by their existence in ancephalous foetuses *after* birth, as stated in the last paragraph. They originate in excitations or impressions made upon the cutaneous surfaces, as many other reflex movements do. We shall afterwards see that the almost incessant and persistent character of the movements in some foetuses during their intra-uterine life, is another evidence of their excito-motory nature. For the “true spinal system never sleeps.”

3.—*The Physiological Object of the Movements.*—The acts and physiological objects of the reflex or excito-motory system are stated by Dr Marshall Hall in the following terms:—“These acts,” says he, “are found to preside over two important classes of functions, viz., those of the *preservation of the individual*, and of the *propagation of the species.*”² It would be difficult to describe in more terse and apposite words the objects aimed at and attained by the position of the head of the foetus over the os uteri at the time of labour. The excito-motory character of the foetal movements, as leading to

¹ See the interesting cases recorded by Dr Barlow, Dr Budd, &c.; or Dr Marshall Hall's own work, *On the Diseases and Derangements of the Nervous System*, p. 234, &c.

² *New Memoir on Nervous System.* (1843). P. 51.

this position, is so far proved by the result of the movements fulfilling both the ends for which reflex motions seem specially designed.

But *how* do excito-motory or reflex motions on the part of the fœtus place the head of the infant below its body, and over the os uteri? In the next sections I will attempt to answer this question, by showing by what means and mechanism these fœtal reflex or excito-motory actions make the child assume and maintain the common position with the head directed downwards; or force it to place itself in malpositions or preternatural presentations under various preternatural circumstances.

END OF PART I.

PART II.

SECTION III.—REFLEX OR EXCITO-MOTORY MUSCULAR MOVEMENTS THE CAUSE OF THE ATTITUDE OF THE FŒTUS.

Let us now attempt to point out the means or mechanism by which the special position of the infant in the latter months, with the head downwards, is assumed and maintained through the instrumentality of the foetal reflex or excito-motory movements. In fulfilling this object, we shall speak first of the position of the foetus at the full term of pregnancy, and the mode in which it is *maintained* by reflex action; secondly, we shall inquire how and when reflex action enables the foetus to *assume* this position; and lastly, we shall offer a few observations on the appropriate stimuli calling the reflex motions of the foetus into action, the parts of its surface most susceptible of the external impressions leading to its reflex motions, and the period of life at which reflex muscular motions are first and principally remarked.

1.—*Mode of Maintenance of the Position of the Fœtus towards the end of Pregnancy.*

At, and (as we have already seen) for some time before parturition, the human foetus is rolled up into an ovoid-formed mass, with its cephalic extremity placed lowest or over the os uteri. When thus placed, it stands, so to speak, upon its head, when the mother is in the erect posture. To comprehend the mode in which this peculiar position is maintained during the latter period of utero-gestation, it is necessary to attend to the relative shapes or forms of the uterus and of the foetus at that period. For it is the relation in shape of the

foetus to the uterus—of the contained to the containing body—that regulates this position. And the maintenance and restoration of the position is effected by reflex movements, when its continuance is from time to time threatened to be interrupted by movements of the mother's body, or by other circumstances affecting the conditions and relations of either the uterus or infant.

The form of the uterus at the full term of utero-gestation is ovoid. See the outline of it from Hunter's most accurate drawing, in Plate II., Fig. 1. "The general figure of the uterus at this time is," says Dr Hunter,¹ "oviform; the fundus answering to the largest extremity of the egg, and the cervix and os uteri to the small end; but the fundus is larger and more flat, or less pointed, in proportion to the lower extremity of the uterus, than one end of an egg is to the other; and the whole uterus seems more or less compressed, so as to be broader from right to left than it is from the fore part backwards."

In the pregnant uterus represented in Plate I., and belonging to Professor Goodsir, the whole length of the cavity of this organ is twelve inches and a half. The broadest part of the cavity is four and a half inches from the fundus, where it measures eight inches across. From this point the organ gradually diminishes in breadth, and tapers downwards towards the cervix. Across the cervix, about three inches above the os, it is about four inches in breadth.

The form of the foetus as it lies rolled up in utero at the full term of pregnancy is ovoid, like that of the uterus itself. "The foetus," says Velpeau,² "forms an ovoid mass, whose large end, turned towards the fundus of the uterus, is represented by the pelvic extremity of the trunk, and the summit (small end of the ovoid) is represented by the cephalic extremity, which rests upon the cervix of the uterus." In Mr Goodsir's preparation (see Plate I.), the broadest part of the larger or pelvic end of the ovoid mass of the foetus measured nearly eight inches, and ran in a line from the lumbar region of the child across nearly to the point where the sole of the foot was applied to the placental surface. The breadth of the smaller or cephalic end of the ovoid (formed by the occipito-frontal diameter of the head) measured about four inches. In other words, the lower end was nearly a half narrower than the upper and broader end of the foetal ovoid.

The figures 1 and 2, given in Plate II., represent in outline the ovoid form of the uterus, and the ovoid form of the foetus at the full term of pregnancy, according to the preceding description of the relative shape and configuration at that time.

Towards the end of pregnancy the foetus is situated in the uterus,

¹ Anatomical Description of the Human Gravid Uterus, p. 3.

² *Traité des Accouchemens*, tom. i. p. 333.

so that the two ovoids which the fœtus and uterus form are relatively adapted to each other; that is, the broad or pelvic end of the ovoid of the fœtus, is placed towards the broad or upper end of the ovoid of the uterus; while the narrow or cephalic end of the ovoid of the fœtus, is placed towards the narrow or lower end of the ovoid of the uterus. The narrow and broad ends of the ovoid mass of the fœtus, are relatively adapted to the narrow and broad ends of the ovoid cavity of the uterus. The figure of the contained body (the fœtus) thus comes to correspond with the figure of the containing body (the cavity of the uterus), and is, as it were, fitted into it. Fig. 3 in Plate II. represents the one ovoid (Fig. 1) thus adapted to the other ovoid (Fig. 2).

At the advanced time of pregnancy of which we are speaking, when the uterus and fœtus are normal in shape and size, the fœtus cannot be placed transversely in the uterine cavity, so as to form a transverse or arm presentation, as there is not room for it to lie in that position. For the long axis of the ovoid mass of the fœtus is about twelve inches; the greatest breadth of the uterus is only eight inches; so that the latter could not receive the former. For the same reason, when once the position with the head downwards is assumed, it comes to be difficult or impossible for the child near the full time to move round in utero, so as to turn its pelvic, instead of its cephalic extremity downwards, and towards the os. In fact a compressible body of twelve inches in length, such as the rolled up fœtus is, cannot readily move through a space of only eight or nine inches, even though that space, like the transverse axis of the uterine cavity, be capable of dilatation and forcible alteration of shape.

At, and towards the full term of utero-gestation, the position of the fœtus with the head lowest, is thus greatly maintained by the relative *physical* adaptation of the ovoid shape of the rolled up mass of the fœtus, to the ovoid shape of the interior of the cavity of the uterus. But this particular adaptation and position of the fœtus in the uterine cavity, would be often lost if no other additional and *vital* means were in operation; as we see indeed often happen when the child dies. The other additional vital means, by whose influence this special position is still further, rigorously and carefully sustained, consists of the restoring influence of reflex motions on the part of the fœtus itself. For, let the relative adaptation and position of the fœtus be partially disturbed (as readily happens by any movements of the mother, as, for example, by her suddenly assuming the upright or supine postures, or other such causes), and immediately the fœtus, by a series of reflex movements of its extremities, particularly of its lower extremities, acts till it regains its former perfect position. It moves, in other words, till it has retaken that position in which it is most free from any marked excitations or compressions upon the external surface of its own body.

It is perhaps unnecessary to add, that seeing the fœtus is placed in

the liquor amnii, a fluid medium of high specific gravity, and is consequently subjected to an uniform amount on all sides of hydrostatic pressure (considerably neutralizing the force of gravity upon its mass), its existing position is easily altered by changes of position and motions on the part of the mother, and consequently on the part of the containing body—the uterus. But for exactly the same physical reason by which the position of the foetus is thus rendered easily capable of change and alteration, the physical powers and means necessary for the restoration of it to its proper position are correspondingly simple. Floating as it does in a liquid medium, the motions of its extremities in that medium, and against the uterine walls, are easily and perfectly adequate, as a mechanical means of motion, to enable it to swim back to, and resume that normal and adaptive position in which it lies most free from extraneous excitations, and from the irritation of disturbing impressions or stimuli upon its own surface. In some mothers the position is apparently easily maintained; the infant and uterus are perfectly adapted to support each other; and consequently the child moves little. In other mothers, or in the same mother in other pregnancies, the movements are nearly incessant. In those cases in which the movements of the infant are great and continuous, the umbilical cord is generally found long, and hence liable to compression; or the cavity of the uterus is large and distended from an excess of liquor amnii, and almost constant movements are required on the part of the foetus to prevent its almost constant tendency to displacement or compression. The nearly uninterrupted constancy of the foetal movements in some mothers, exists to a degree greater than is observed in any voluntary muscular movements. But the excess of foetal movements corresponds in this respect with the law of constancy, which regulates other corresponding excito-motory movements in the animal economy. Voluntary muscular movements always become temporarily arrested and interrupted from time to time; because, from time to time, volition, like other cerebral acts, must temporarily cease for the purpose of rest and renovation. Fatigue, and its antidotes repose and sleep, necessarily belong to the cerebral system; but the spinal system never sleeps, and the reflex or excito-motory muscular movements over which it presides, are not susceptible of fatigue, and do not necessarily require any intermission in their action. It is on this principle that respiration in man is unattended by fatigue, and that “the long flight of birds in their migrations, and of flies, which are all the day long on the wing, is sustained.”¹ Some of the reflex or excito-motory movements of animals which show this law of con-

¹ Diseases of the Nervous System, p. 26; “I suspect, indeed, that the migratory traveller is frequently actually visited by nature’s sweet rest, even during its aerial transit.” New Memoir, p. 32. The young infant often evidently continues the act of sucking (an act of the spinal or reflex system) while the cerebral system is asleep.

stancy, have the same object and effect as the reflex movements of the fœtus; viz., the maintenance of position. Thus, the fish holds and maintains its position in the stream by constant reflex movements of the fins and tail.

2.—*Mode of Assumption of the Natural Position of the Fœtus with the Head downwards.*

I have already stated (p. 6) that the position of the fœtus, with the head over the os uteri, is not observed till the latter months of utero-gestation; that in fœtuses expelled before the end of the sixth month, presentations of the feet or pelvis are as frequent as presentations of the head, and presentations of the shoulder by no means infrequent; and that the position of the head lowest, and towards the os uteri, comes to be taken with more and more certainty from the end of the sixth month, onward to the full term.

From the observations collected by Professor Dubois at the Maternity Hospital of Paris, I have constructed the following table in evidence of the preceding remarks. The respective results of the presentations among children born before the end of the sixth month, during the course of the seventh month, and at the full time, include, it will be observed, all cases whether the child were alive or dead at the time of its expulsion. The return for the eighth and ninth months, refers only to children born dead. He does not give any return relative to the children born alive during these two months.

Table of the Relative Proportion of Head Presentations, as varied by the date of the Pregnancy or Labour.

Period of Pregnancy.	Total Cases.	Presentations of			Per centage of Head Presentations.
		Shoulder.	Breech.	Head.	
Before end of sixth month,	121	5	51	65	52 in 100
During seventh month,	119	6	31	82	68 in 100
During eighth and ninth months, }	96	2	22	72	76 in 100
At full term of gestation,	100	1	3	96	96 in 100

The facts in this table sufficiently prove that the position of the fœtus with the head lowest and over the os uteri, does not begin to be assumed till about the end of the sixth month, and that it is taken up with increasing frequency and certainty from that period onward to the full term of pregnancy.

The double fact of the position not being assumed before the period in question, and of its being more and more positively and steadily assumed after this period, is simply, I believe, ascribable to the circumstance, that before the sixth month there is no adjusting correspondence of figure between the uterus and fœtus; while, after

the sixth month, the figure of the one comes to correspond more and more to the figure of the other, and consequently requires more and more the containing body to be placed in the containing cavity in that kind of relative adaptation which has been already described.

All anatomical authorities allow that the uterine cavity before the sixth month¹ is spheroidal, and not ovoid, the neck of the organ not yet being developed and taken up to form part of the cavity. The foetus, up to this time, is not folded up so compactly as afterwards, or moulded into its ultimate ovoid form. Further, at the same period the uterine cavity is not only roundish in form, but is relatively much larger in regard to the foetus—for it contains a large quantity of liquor amnii.² After the sixth month these various circumstances are gradually altered. The cavity of the uterus becomes more and more ovoid in form, from the development of the cervix; the quantity of liquor amnii becomes less and less, relatively to the increasing size of the uterus and infant; the infant itself becomes in a greater and greater corresponding degree deprived of space—is forced to alter its shape and position according to the shape and form of the uterine cavity—becomes more folded and compacted together, because its containing space is less—and ultimately becomes comparatively fixed in the position which it is thus forced to assume. “In the last two or three months of gestation, the child,” observes Dr Hunter,³ “is commonly so much straitened for room, and so compactly adapted to the oblong figure of the uterus, that it cannot change its general position either by its own efforts, or even by accidents happening to the mother.” “When,” he elsewhere remarks,⁴ “there is a considerable quantity of liquor amnii, the child takes the advantage of room, and the composition of its parts is not so close or globular. In proportion as there is less room, its figure is more compacted and moulded to the shape of the cavity of the uterus.”

These changes, however, in the physical shape and size of the uterine cavity, relatively to the physical form of the foetus, would not produce of themselves the position with the head over the os uteri. The dead child does not take this position. If the child has been alive

¹ See Plate II. Fig. 4, sketched and drawn from a case of five or six months pregnancy, delineated by Breschet and Velpeau.

² “The relative proportions,” says Ramsbotham, “between the quantity of fluid and size of the embryo, differ much at different stages of pregnancy, being considerably greater at the early periods, and less at the advanced stage. Thus when the embryo is scarcely visible to the naked eye, there is from half a drachm to a drachm of water collected within the membranes. Where the embryo is not so large as a small kidney bean, there would be an ounce or more of liquor amnii; while at the end of gestation, when the foetus weighs, on an average, nearly seven pounds, the amount of fluid seldom exceeds a pint. The quantity, therefore, though positively increasing with the growth of the ovum throughout the whole of gestation, is relatively to the size of the foetus gradually diminishing.”—*Obstetric Medicine and Surgery*, p. 69.

³ Anatomical Description of the Gravid Uterus, p. 67.

⁴ *Ib.* p. 63.

up to the seventh, or eighth, or ninth months, and has in consequence assumed the position in question, but then dies—the position is liable to be lost from the death of the child. At pp. 10 and 11, I have given two tables proving this fact, and showing how much the assumption, as well as the maintenance of the position, with the head downwards, is a vital act, and connected with the existence of life in the child. The regulating vital power guiding it to the assumption of that normal position in which its figure corresponds as exactly as possible to the figure of the uterine cavity, consists of a succession of reflex or excito-motory movements of an adaptive kind on the part of the fœtus, excited by impressions made on its external surface. In order fully to understand their action, we shall next briefly consider the origin and effects of those adaptive reflex movements, which thus contribute not only to the original assumption, but to the continued maintenance of the position of the fœtus,—and force it to take up, retain, and restore itself to that special position in the uterine cavity in which it can lie with its form more perfectly adjusted than in any other position to the form of the uterus, and with its own excitor surfaces more removed than in any other position from the action of external impressions and stimuli.

3.—*Nature of the Physical Impressions, or Stimuli, exciting Reflex Movements on the part of the Fœtus.*

“All animals,” says Harvey, “while they are at rest or asleep, fold up their limbs in such a way as to form an oval or globular figure. . . . So, too, the infant in utero is generally disposed after this manner. In such a position is the embryo usually found as that which we naturally take in sleep.”¹ This folded up state of the limbs and body of the fœtus is primarily the effect of the well known greater muscular tone and contraction of the flexor than of the extensor muscles. Of the power and preponderance of the flexor over the extensor set of muscles, we have evidence remaining for some time after birth, in the almost constant state of flexion which may be observed in the extremities, and particularly in the lower extremities of the new-born child, when unirritated and at rest. It is not in general for some considerable time after birth that the child acquires the full power of extending the lower extremities. And, no doubt, this superior tone and contraction of the flexor muscles is one of the means by which the necessary ovoid form of the fœtus in utero is maintained. But while this physiological principle² accounts for that form and figure of the fœtus which best adapts it for the form and figure of the uterus, we

¹ Harvey's Works (Sydenham Society Edition), p. 522.

² Dr Hall, it is well known, holds that the reflex function, in its natural state, constitutes the principle of equilibrium and tone of the whole muscular system.—*Memoirs on the Nervous System*, 1837, p. 38.

must have recourse to the acts of the reflex system in another view, in order to account for the adaptive position, or rather adaptive movements of the fœtus. These movements are reflex. And it is laid down as an established physiological law, that "the reflex nerves are in every case, without an exception, excited to action by the impressions of *physical* agents acting on the peripheral extremities of incident nerves;"¹ and "that the reflex power is never exercised without the excitement caused by the application of a physical agent either to the external or internal *surfaces* of the body."²

In relation to the movements of the fœtus in utero, let us next, then, inquire what physical agents produce the required excitor impressions, and on what surface, or the peripheral extremities of what incident nerves, these impressions act?

Various physiologists have pointed out that, when in the lower animals the head is removed, or the spinal cord is divided, and sensation thus abolished, the mere touching or irritation of the *skin* is followed by more or less complex movements in the *muscles* of the extremities and trunk. Whytt, for example, long ago "remarked that, after decapitation, frogs and serpents performed movements of the limbs or entire body, consequent upon the application of a stimulus to the skin."³ "In the frog," says Mr Grainger,⁴ "in the rabbit, kitten, &c., after all feeling and volition is lost, the *limbs* are moved when the *skin* is touched." The movements thus excited under these conditions (decapitation and division of the cord) are evidently reflex or excito-motory, and the facts prove how powerful an excitant surface *the skin* is, and how easily irritations of it act in calling up or producing reflex muscular movements. "No part," says Müller, "equals the skin in the property of exciting reflex motions; the slightest touch applied to the surface, in animals in a state of narcotization, is frequently sufficient to give rise to strong spasms,

¹ Grainger's Observations on the Structure and Functions of the Spinal Cord, p. 50.

² Ibid, pp. 119, 129.

³ Ibid, p. 3.

⁴ Ibid, p. 49.—"Every physiologist," says Mr Grainger, "who has divided the spinal cord in living animals, and has then pricked or otherwise irritated the *skin*, has remarked the free motion which is thereby caused in the muscles which are called voluntary,"—p. 100. When the spinal cord is divided, "the foot of the rabbit is not only drawn away from the irritation, but the whole limb, occasionally even both legs, are thrown backwards, with all the complicated motions that occur when the creature runs. In the frog, if the cord be divided sufficiently high, both hind legs often strike out when one is touched, not in the manner of the rabbit, but with the very action that occurs in swimming. The chicken, in the experiment of Flourens, when deprived of all volition, flew when thrown into the air. Lastly, in the human body, the legs may be incited to motion, when all voluntary power is destroyed, by tickling the sole of the foot. It is thus proved, beyond the possibility of a doubt, that motions similar to those performed in the progression of the animal may be excited by touching *the skin*, when volition and sensation are destroyed,"—p. 150.

while the reflex actions excited by irritation of the nerves themselves are much slighter.”¹

I have already stated (page 18) that movements of the limbs of the child are readily produced *after* the period of its birth, by irritation of the sole of the foot and other parts of the cutaneous surface; that *during* birth, and while labour is going on, similar movements can be produced by similarly irritating the presenting part of the child; that *before* birth, or, in other words, during pregnancy, the same kind of movements is excited by irritating the limbs or body of the fœtus through the abdominal or uterine walls by the hand, stethoscope, &c.; and that in all these cases the movements thus produced are reflex or excito-motory, and not voluntary, inasmuch as they occur in anencephalous fœtuses entirely wanting a brain, as distinctly as in those that are normal in structure.²

Cutaneous impressions, or physical irritations applied to the peripheral extremities of the incident nerves distributed to the surface of the skin, are thus capable of producing reflex-motory actions on the part of the infant, and are, perhaps, the most common cause of excitement of the muscular movements of its extremities, and consequently of its changes of position. If the fœtus be temporarily thrown out of position by any movements on the part of the mother, and if the surface of its body thus become irritated at any point or points by mere pressure from or against the opposing uterine parietes, or other resistant substances, this pressure (like the pressure of the hand or stethoscope, alluded to in the preceding paragraph) will act as an excitor stimulus, calling up reflex motions calculated and empowered to move away the irritated and compressed limb or body from the agent or source of the irritation. Different postures of the mother, when suddenly assumed, by both displacing the fœtus and altering the shape of the uterus so as to make its parietes press upon the fœtus, are followed for a time by a succession of movements on the part of the infant.³ Thus the acts of suddenly rising or suddenly lying down excite almost constantly, in certain women,

¹ Müller's Physiology (Baly's Translation), vol. i., p. 322; see also Longet, Anatomie et Physiologie du Système Nerveux, vol. i., p. 318.

² Unzer, whose remarkable works contain such clear and comprehensive views, in many points, of the physiology of the nervous system, makes a remark upon this subject which is too striking to omit in evidence. "A living anencephalous monster, when born, draws itself up, if you puck or burn its limbs, and that plainly through a reflex operation of the nerves—[durch eine blosser nervenwirkung zurück]—as a natural new-born child would do, if you made the same external impressions upon it."—*Erste Gründe einer Physiologie*, p. 552.

³ "That the different attitudes of the mother's body should produce alterations in the figure of the uterus, needs not now a particular explanation or proof. The weight of the uterus itself, and of the adjacent viscera, being differently directed, must produce some change of posture, especially as the parts against which the uterus will rest its weight in the different postures of the body are of such different natures."—*Hunter's Anatomical Description of the Gravid Uterus*, p. 4.

motions on the part of the child. When some mothers stoop or lean forward, they alter the shape of the uterus, and compress the child so greatly as to call up instantly such strong foetal motions as to oblige them immediately to assume the erect posture. And the foetus sometimes throws itself into positions which excite new movements on its own part. In the latter months, "it is frequently evident," says Dr Hunter,¹ "that some awkward straightened position of the child being produced by its own motion, and pressing or stretching the uterus unequally, gives the mother much uneasiness for a time; and then, upon the child's stirring in some remarkable way, it gets to be more at its ease, and the mother feels instant relief from the pain, the stretching, or whatever the complaint was. This will happen to the same woman again and again."

In the various cases and conditions which I have mentioned,² the *cutaneous* impressions and stimulations call up reflex *motions* in the foetus according to the laws laid down by all those physiologists who have written upon the subject of excito-motory phenomena. "An impression is made," to use the language of Dr Marshall Hall, "upon the extremity of a nerve (or nerves); this impression is conveyed, not to the cerebrum, but to some part of the medulla oblongata or medulla spinalis, whence it is reflected upon certain muscles destined to be excited into consentaneous action."³ "The external impressions," as Prochaska⁴ writes it, "that are made upon the sensorial nerves, are most swiftly propagated along the whole length of the nerves to their origin, where, when they have arrived, they are reflected according to a certain law, and pass on to certain and corresponding motor nerves, through which, being again very swiftly propagated to muscles, they excite certain and determinate movements." The views which Prochaska took of the general object and aim of such reflex or excito-motory movements are precisely those

¹ Anatomical Description of the Gravid Uterus, p. 67.

² All the conditions I have spoken of in the text relate to cutaneous irritations and impressions acting as stimuli to reflex motions. In cases of prolapsus of the umbilical cord, compression of the prolapsed funis by the fingers or otherwise seems generally to lead to a series of reflex movements of the body and limbs of the foetus. During pregnancy this may be one of the means employed by nature to prevent, more frequently than otherwise would happen, the position of the cord between the child's head and the interior of the uterine cervix. It is certainly remarkable that we do not meet with this position of the cord more frequently, when we consider its length and its greater specific gravity than the liquor amnii. If, when so placed, and consequently compressed, reflex foetal movements were always excited, this circumstance may possibly be the means of leading to, or producing, one other result—viz., the ultimate course and twisting of the cord around the body, neck, or limbs of the foetus; in other words, such convolutions of the cord around these parts may be the result of sanitary reflex movements on the part of the foetus—these sanitary reflex movements originating in, or being excited by, some unsafe or uneasy compression of the cord itself.

³ Memoirs on the Nervous System, p. 70.

⁴ Annotationes Academicæ, fasc. iii., p. 114.

which are attained by the aforesaid movements of the fœtus in utero. "The general law," he observes, "by which the common sensorium reflects sensorial impressions into motory, is the preservation of the individual (*conservatio nostri*); so that when external impressions act that are hurtful to our body, there follow certain motory impressions producing motions combined for the purpose of removing and driving away this irritation from our body; and, on the contrary, when external or sensory impressions act that are grateful to us, there follow internal or motory impressions productive of motions, having for their object the further maintenance of this grateful condition."¹

All the so-called voluntary or motory muscles of the fœtus are not excited to an equal degree, or with equal facility, by the action of the physical impressions or stimuli to which it is subjected. The muscles of the trunk and upper extremities are much less moved under these stimuli than the muscles of the lower extremities are. Various authors have remarked incidentally, and without a view to any theory, that apparently the lower extremities move in utero much more than the upper.² Indeed, for some time after birth the movements of the legs continue to be greater in degree and extent than the movements of the arms. In the fluid medium in which it lies and swims in the uterine cavity, the motions of the lower extremities of the fœtus are more useful and powerful in enabling it to maintain and resume its position than any movements of the upper extremities could be.—And even in the adult, when the influence of the mind and cerebral system is withdrawn, reflex movements are far more easily excited as in the fœtus, in the lower than in the upper extremities. When a man receives an injury, producing fracture or displacement of one or more of his cervical vertebræ, and paraplegia in consequence is produced, "we find," says Dr Todd, "the patient presenting the following phenomena. His trunk and extremities appear as if dead (except the movements of the diaphragm); while the head lives. In full possession of his mental faculties and powers, he is, nevertheless, unconscious, save from the exercise of his sight, of any changes which may affect the parts below his head, nor is the utmost effort of his will sufficient to produce a movement of any, even the smallest, of these parts. If the stunning effect of the accident have passed off, tickling the soles of the feet will be found to cause movements, of which, as well as of the application of the stimulus, the patient is unconscious. The limbs may be irritated in various ways, but without exciting any effects which the patient can perceive, excepting movements, and these he is aware of only from his happening to see them. It is *important* (adds Dr Todd) to notice that, in cases of this

¹ Annotationes Academicæ, p. 117.

² Thus, for example, Professor Dubois observes, "Il ne faut pas oublier que les grands mouvemens du fœtus, et les plus ordinaires sont ceux qu'exécutent les extrémités abdominales."—*Memoires de l'Académie*, vol. ii., p. 285.

kind, movements are difficult of excitation in the *upper* extremities, while they are aroused with great facility in the lower.”¹

4.—*Are there any parts of the Cutaneous Surface peculiarly susceptible of the appropriate physical impressions or stimuli leading to the Reflex Motions of the Fœtus?*

In the fœtus after birth some parts of the cutaneous surface, when stimulated, give rise much more readily than others to reflex muscular motions. In the adult the skin of the soles of the feet, of the knees, and of the sides, are thus specially susceptible. In other words, these parts are more sensitive than other parts to the irritation of touching or tickling. This over-susceptibility in the cutaneous nerves of these special parts is of no apparent use in the adult; and yet there is no property without its utility. It becomes generally more and more diminished and lost as life advances, and is greater in degree the younger the person, and greatest of all in the infant. Has this property not *its* special utility in the infant before birth? The parts of the fœtal surface most exposed to external irritation, the soles of the feet, knees, and sides, as seen in Plate I. and Plate II., are exactly those parts which are super-sensitive after birth to cutaneous irritation, and which most readily produce reflex movements of the limbs, in consequence of their cutaneous irritation. In a new born infant irritation of the sides of the chest is followed by more or less strong movements of both lower extremities. Rubbing or tickling the soles of the foot immediately excites a movement of change of position and retraction. “Certain localities,” says Dr Hall, “are more susceptible than others to the effects of the excito-motory stimulus—the sole of the foot is especially one of these. Dr Little,” he continues, “has published an interesting case of distortion of the foot, which only, but uniformly, occurred when it was placed upon the ground. Dr Dieffenbach met with a similar case”²

In anencephalous infants the same special parts of the cutaneous surface are principally or solely those through the irritation of which muscular movements are excited, when such infants survive after birth. In his Croonian Lecture on Muscular Motion, Sir Gilbert Blane describes some experiments upon a kitten which he decapitated, and upon another in which he divided the cord; and he states that after these injuries of the nervous centres, when the hind paws were irritated, “the muscles belonging to the posterior extremities were thrown into contraction, so as to produce the motion of shrinking from injury.” He subsequently adds, “In an acephalous monster the like phenomena were observable. It moved up its knees when the *soles* of its feet were tickled, &c.”³

¹ Physiology of the Nervous System (Encyclopedia of Anatomy), p. 19
See also Todd and Bowman's Physiological Anatomy, vol. i., p. 334.

² Diseases and Derangements of the Nervous System, p. 117.

³ Select Dissertations on Medical Science, p. 262.

The results of pathology strikingly prove that there are some portions of the cutaneous surfaces which are much more susceptible than others, of producing reflex muscular movements, under the application of appropriate excitants. This is particularly seen in some cases of complete paraplegia depending on disease or division of the spinal cord,—and where all power of sensation and volition is abolished, as far as the paralyzed limbs are concerned. In instances of this kind, described by Drs Hall, Barlow, Budd, and others, the muscles of the paralyzed limb, though in no way obedient to volition, were capable of being excited into temporary action by various irritations of the cutaneous surface of the limb, but particularly by tickling of the sole of the foot.¹ Thus, in a case described by Mr Grainger, “a girl about fifteen years of age, was affected with angular curvature of the spine, producing insensibility and paralysis of the lower extremities. On tickling the *soles* of her feet, which, as an experiment, was often done, the legs were immediately slightly retracted, although the patient said she felt nothing; it was further remarked, that on touching the *other* parts of the feet or the legs in the same manner, no effect was produced.”² “The results,” observes Mr Grainger, “noticed in these cases are full of interest. They prove, first, that in parts of the body indisputably deprived of all feeling and power of voluntary motion, contraction may be excited in the so-called voluntary muscles, by impressions made on the skin; secondly, that this capacity of exciting muscular contractions, is not equally possessed by all parts of the external surface of the body, but that the *sole* of the foot is that precise part in which the action is excited in the most energetic manner.”³

In cases of hemiplegia, particularly when the paralysis is complete, the same phenomena may be frequently observed. “In such cases,” observes Dr Todd, “it is wonderful how easily movements may be excited in the palsied leg—very rarely in the arm, by the application of stimuli to the *sole* of the foot, or elsewhere with less facility. The patient, who acknowledged his utter inability to move even one of his toes, is astonished at the rapidity and extent to which the *whole* lower extremity may be moved by *touching* the sole of the foot, even with a feather.”⁴ The development of these excito-motory phenomena in paralytic cases is frequently (adds Dr Todd), “in the inverse proportion of the withdrawal of the power of the will.”⁵ And in the same way, and on the same principle, the *excito-motory reflex* muscular movements of the fœtus are probably only the more marked in

¹ See Diseases of the Nervous System, p. 233, &c. &c.

² Observations on the Spinal Cord, p. 94.—³ Ibid, p. 94. See also Dr Budd's paper in *Mad. Chir. Trans.*, vol. xxii., p. 187: “Impressions on the *soles* of the feet were more efficient than any that were tried on other parts of the skin.”

⁴ Physiology of the Nervous System, p. 19.

⁵ See also Dr Budd, in *Medico-Chir. Trans.*, vol. xxii., p. 186: “The reflex movements varied in extent and force, inversely with the degree of voluntary power.”

degree and extent, in consequence of the absence during intra-uterine life, of all volitional and other mental influences. This remark leads us to a new subject, viz. :—

5.—*The degree of Reflex or Excito-Motory Movements manifested by the Fœtus in Utero, and the Period of their Commencement.*

In adult life the influence of, and susceptibility to, reflex movements in the so-called voluntary muscles of the trunk and extremities, is masked by the predominating power and effects of the mind and cerebral system over these same sets of muscles. Their excito-motory activity, however, is only obscured, not obliterated. Disease, by sometimes separating the influence of the cerebral system from the influence of the spinal system over these muscles, proves to us the persistence of their excito-motory activity, as in the cases of paraplegia and hemiplegia, adverted to in the two preceding paragraphs. These cases shew us by a kind of pathological analysis, that even in the adult, when the motory muscles of the trunk and extremities are withdrawn from the psychical nervous influence of the cerebral system, they are still found remaining subject to the physical nervous influence of the reflex or spinal system. “The truth,” remarks Dr Hall, “is that the intellectual functions are daily developed during the first years of life, and obscure those of the excito-motory; but the latter are not enfeebled during this change, which is one of super-addition, not of substitution.”¹

All modern physiologists, however, admit that reflex or excito-motory movements are more distinctly and more powerfully developed, and are entrusted with the performance of more and more important functions in the animal economy according as we descend in the scale of animal life, and consequently also in the scale of individual life. In other words, the younger the individual is, the more evident and marked, as a general rule, is the power and influence of the reflex movements. “It is worthy,” says Dr Hall,² “of special observation, that, in the very young animal, and in the cold-blooded animal, the phenomena of the excito-motor power are far more vividly manifested than in the older and the warm-blooded. In the very young kitten, even when asphyxiated to insensibility, every touch, contact, or slight blow—every jar of the table, any sudden impression of the external air, or that of a few drops of cold water—induces at once energetic reflex movements and acts of inspiration. The nostrils, the tail, the soles of the feet, the general surface, are all extremely susceptible, and in degree in the order in which I have mentioned.” “Phenomena of this nature,” observes Professor Todd, “may be produced in all vertebrate animals. They are, however, especially marked in the cold-blooded classes. In the young of warm-blooded animals they are more manifest than in the adults of the same class.”³

¹ Diseases and Derangements of Nervous System, p. 138.

² New Memoir on the Nervous System, p. 29.

³ Physiology of the Nervous System, p. 18.

In accordance with the principle stated in the preceding paragraph, we ought to expect the manifestations of reflex movements to be well marked in the fœtus. And the whole of the present inquiry is intended to show that they are so, in particular sets of muscles, viz., in those connected with the general movements of the body. Other sets and combinations of muscles subject to excito-motory action after birth, as those of inspiration, suction, deglutition, defecation, &c., &c., are still in the state of absolute quietude during intra-uterine life, because the appropriate physical stimuli calculated to excite these reflex movements, are never applied till extra-uterine life is commenced, and because their action during intra-uterine life would be dangerous and even fatal to the fœtus. On the other hand, we have seen that the appropriate stimuli, calling into exercise the motory muscles of the trunk and extremities are applied during intra-uterine existence; and the action of these muscles is necessary on the part of the fœtus, in order to enable it to assume and maintain its position with the head downwards, an action which is in itself characterised by being intimately connected, as other excito-motory actions are, “with the preservation of the individual, and the propagation of the species.”¹

In several parts of his works, Dr Hall speaks of the extent of the phenomena referable to the nervous system that are manifested in fœtal life. But in consequence of not adverting to some of the points which have been attempted to be stated in the preceding pages, he takes too limited, and consequently, as I am inclined to believe, an erroneous view of the extent of the excito-motory or reflex muscular movements and actions that occur during intra-uterine life. “The fœtus in utero seems,” says he, “restrained to a sort of ganglionic life. Every thing consists in nutrition and growth, or development. The contact of the liquor amnii is sufficient to keep the eyelids, the lips, and the sphincters closed.”² “The fœtus in utero is,” he again observes, “so little exposed to the influence of stimulants, or excitants applied to the cutaneous or mucous surfaces, that the excito-motory property is comparatively little called into action in the form of the reflex function. The contact of the liquor amnii may preserve the lips or the larynx, and the sphincter ani, closed. In this manner, the reflex function, or the function of exclusion and of retention is in activity; but, as the agent in ingestion and egestion, it is as if it did not exist.”³

In these, and the other passages in which he alludes to the state of the nervous system of the fœtus, Dr Hall nowhere, as far as I am

¹ The “functions” of the “true spinal excito-motory system” are, as repeatedly explained and laid down by Dr M. Hall, those functions of the economy “on which depend, 1, the preservation of the individual; and 2, the continuance of the species.”—*Diseases of the Nervous System*, p. 39, &c; *New Memoir*, p. 51; &c.

² *Diseases and Derangements of the Nervous System*, p. 131.

³ *Diseases and Derangements of the Nervous System*, p. 243; see also p. 113, &c.

aware, adverts or alludes to the strong and well marked reflex movements and actions performed during intra-uterine life by the motory muscles of the trunk, and particularly of the limbs of the fœtus, and which constitute, as I have endeavoured to show, the mechanism by whose instrumentality nature ultimately effects and produces in the human uterus, the normal and salutary position of the child with the head downwards and over the os. At what period of intra-uterine life reflex movements first commence in these so-called voluntary muscles, we have no power of precisely determining. The exercise of these reflex movements is not essential for the principal object which they seem intended to accomplish (namely, the proper position of the fœtus), till the latter period of pregnancy. But the fœtus is usually felt by the mother moving as early as the middle term of utero-gestation; and stethoscopic observations show that they are often present to some extent before they come to be perceived at the time of quickening. "During the early stage of pregnancy," says Nægele, "while the fœtus is very small in proportion to the size of the cavity which contains it, and while the free movements of its limbs are consequently unrestrained, sounds produced by the movements of the fœtus may be occasionally distinguished as gentle taps repeated at intervals, and continued uninterruptedly for a considerable time. These sounds may sometimes be distinguished *several weeks before* the mother becomes conscious of the motion of the child, and also earlier than the pulsations of the fœtal heart, or the uterine souffle." ¹

In comparative physiology, we may have even *ocular* proof of the early commencement of reflex or excito-motory movements in the limbs, &c., of the embryo. In marsupial generation, the embryo, as is well known, leaves the uterus very early, and becomes immediately affixed to the nipple protruding in the interior of the marsupial sac, where it continues its development and growth. In the kangaroo, the embryo is expelled from the uterus as early, according to the observations made by Professor Owen, as the thirty-ninth day. An embryo of the kangaroo expelled at that period, was watched and examined by Mr Owen, and to use his own words, it "resembled an earth-worm in its colour and semi-transparent integument," and in the degree of development, its brain corresponded to that of the human embryo at the ninth week. Yet, in this early stage of development, the existence in it of reflex actions and movements was most distinct, for it breathed, *moved its limbs when touched*, and fixed upon the marsupial nipple. "It adhered freely," says Mr Owen, "to the point of the nipple; breathed strongly but slowly, and moved its fore legs when disturbed." ²

¹ Treatise on Obstetric Auscultation, p. 50.

² Cyclopædia of Anatomy—article Marsupialia—Vol. III., p. 322.

